

or a Fahrenheit attached thermometer may be used with a metric scale. In all such cases the temperature must be brought into the same system of units as the observed scale reading before corrections can be applied, and the observed reading must then be corrected for temperature before any conversion of the scale units can be made.

It need hardly be said that the foregoing remarks do not apply to readings of aneroid barometers whose corrections for temperature and instrumental error can not be definitely tabulated, each instrument requiring a specific table peculiar to that one instrument. These corrections are too generally quite ignored and not applied.

The proper course, in case barometric readings must be converted from one system of units to another, is to apply all known corrections expressed in the same system of units as that in which the observed scale reading is taken and then convert the corrected reading.

WEST INDIAN SERVICE.

By Prof. E. B. GARRIOTT, in Charge (dated August 3, 1898).

By virtue of an Act of Congress, approved July 7, 1898, the Chief of the Weather Bureau, under the direction of the Secretary of Agriculture, was authorized, through proper diplomatic channels—

To establish and equip meteorological observation stations of the same general character as the stations of the Weather Bureau now maintained in the United States, at such points in the West Indies and on the coast of the mainland, bordering the Caribbean Sea, and on the islands adjacent thereto, as might be needed.

The purpose of the establishment and equipment of observation stations in the regions named was—

To have daily observations on meteorological phenomena taken at the several stations, to collect reports thereof, by cable and otherwise, and to disseminate information based thereon of the approach of tropical hurricanes or other storms to the West Indies, and to the coasts of the United States, and to collect and publish such further climatological data as might be of public benefit.

With the approval of this Act operations were actively begun to establish stations of observation and report. Communications requesting permission to do this were addressed through the proper official channels to the several European governments having jurisdiction in the West Indies, observers, skilled and trained in the work of the Bureau were selected, and the necessary instrumental equipment for stations was prepared for transportation to selected points. Observers reported their arrival at Willemstad, Curacao, July 21; at Santiago, Cuba, Kingston, Jamaica, Port of Spain, Trinidad, July 29; at Santo Domingo, Santo Domingo, and St. Thomas, August 5; at Barranquilla, Colombia, South America, August 11; at Bridgetown, Barbados, August 12; at St. Christopher (St. Kitts), August 18, and at Colon, Colombia, South America, August 29.

Observations were regularly begun at five of these, i. e., Kingston, Santo Domingo, St. Thomas, Port of Spain, and Willemstad, August 9, at Santiago, August 11, and at Bridgetown, Barbados, August 31. Similar reports have been received daily for a long time from Habana, Cuba; Nassau, Bahamas; and Hamilton, Bermuda.

The central station is located at Kingston, Jamaica, and all other stations of the system cable daily, to Washington and Kingston, reports of observations taken at 6 a. m. and 6 p. m., seventy-fifth meridian time. In the presence of unusual weather conditions, or in the event of observed premonitions of approaching hurricanes, special observations are telegraphed. In addition, and supplementary to the above-named West Indian stations, daily morning and evening reports are telegraphed (beginning August 9) to Washington via Galveston, Tex., from Tampico, Vera Cruz, and Coatzacoalcas; these stations on the Gulf of Mexico are manned and observations con-

tributed by the officials of the Mexican Telegraph Company. Daily reports are also received (beginning August 17) by telegraph from a local observer at Merida, Yucatan.

The present plan of hurricane warnings provides that upon the receipt by the Weather Bureau at Washington of telegraphic information of the development of a hurricane in the West Indian regions, warning of the location, character, and probable movement and strength of the storm be furnished at any hour of the day or night to the Chief of Bureau of Navigation, Navy Department, who has provided for a prompt transmittal of the information to our fleets in West Indian and southern waters. Similar advices will be cabled directly to West Indian and southern coast ports in the threatened district and every available means will be employed in the interest of the naval and merchant marine to give the most effective distribution to the warnings.

The service above outlined is at present an emergency service, which has been hastily organized to meet a demand on the part of naval and commercial interests for warnings of destructive storms in the Gulf, Caribbean Sea, and the West Indian Islands. It is not organized for local climatic studies, but it is confidently expected that through the cooperation of representatives of European governments having possessions in the West Indies, and of the countries bordering on the Caribbean Sea and the Gulf of Mexico on the south and west, a system of weather reporting stations can be permanently established, which will not only permit the forecasting of hurricanes and northers but allow of such a determination of the climatic conditions as will be a most important factor in developing the wonderfully rich agricultural resources of the West Indian Islands.

THE JAMAICA WEATHER SERVICE.¹

By Mr. MAXWELL HALL, Government Meteorologist (dated August 15, 1898).

This Service was established in 1880 in order to have the usual instruments read and recorded at Kingston, the chief town in Jamaica, to encourage the registration of the rainfall throughout the Island, and to give warning of approaching hurricanes.

Mr. Robert Johnstone, F. R. Met. S., has assisted me from the first; he undertook the registration of the instruments in Kingston, and thereby allowed me to return to my private residence, the Kempshot Observatory, near Montego Bay. These places are 78 miles apart on the line of usual approach of cyclones along the Caribbean Sea. Consequently, by an exchange of telegrams Mr. Johnstone and I have been able to make out fairly well what any cyclone was doing, and to issue the proper telegraphic notice or warning.

At times, during the absence of Mr. Johnstone, I have been assisted by Mr. J. F. Brennan, who has shown unusual skill in improving self-registering instruments.

The registration of the rainfall has been encouraged by issuing a monthly weather report to all the contributors, of whom there are about 200; among these weather reports there are published any special reports or investigations.

With regard to storm warnings, according to a revised list, 38 depressions have passed within barometric range of Jamaica since the service was established, but many were so clearly

¹ The article here communicated in response to a request by the Editor was originally prepared by Mr. Maxwell Hall as a response to a request from the Royal Meteorological Society, and may possibly be published in abstract in connection with the annual address of its President, Hon. F. C. Bayard. With regard to the General West Indian Service, partially organized at one time by Mr. Hall, a full account will be found in his introduction to Volume I of the Jamaica Meteorological Observations. We are pleased to learn that the recent effort of the Weather Bureau to organize a West Indian system meets with Mr. Hall's heartiest approval. In fact there is every assurance of friendly cooperation on the part of all the meteorological organizations now existing in the West Indian region.—Ed.

due to cyclones at a distance which were not coming our way that we can not claim to have seriously dealt with more than twenty or so. At any rate no mistake has yet been made; the hurricane signals have been ordered up only thrice, August 18, 1880, August 20, 1886, and September 15, 1889.

Forecasts for daily rainfall were fairly successful, but could not reach those interested.

Forecasts for monthly rainfall were commenced in 1884 and discontinued in 1886; of these 80 per cent were correct, but the subject required more attention than I could give it, and when a large rainfall was forecast for May, 1886, which month proved unusually dry, and when with an average forecast for June, 1886, heavy rains fell June 5, and 6, and floods did great damage, it was clearly time to stop this mode of forecasting.

The following are the investigations which have been undertaken:

Barometer, diurnal variation of.—For every hour for each month of the year. (Weather report No. 192.)

Barometric pressures, mean (W. R. 192, and errata Vol. II).—Very special photographic arrangements were made by Mr. J. F. Brennan, who took and reduced the observations. With regard to the mean, it was found that the mean of the three readings at 7 a. m., 3 p. m., and 11 p. m. exactly agreed with the mean of the readings taken every hour.

Clouds, classification of (W. R. 193).—The classification is essentially the same as that adopted by the International Committee, but strato-cirrus was added; it is a cloud somewhat resembling cirro-stratus, but thick and woolly; it is a purely tropical cloud according to Mr. Abercomby.

Cyclones of 1880 (W. R. Vol. I, introduction).—An investigation of the two cyclones which passed over Jamaica August 18, that year, including their reciprocal movements.

Cyclones, generally, as observed in Jamaica (W. R. 96).

Cyclones, tropical (Nature, vol. 46, p. 393).—If a cyclone is approaching any place the time of arrival is the fall of the barometer below the mean divided by twice the rate of fall, and consequently it is possible to ascertain whether the cyclone is directly approaching or not, by the constancy in the time of arrival, as shown by observations made every two or four hours. This rule is most useful for isolated places.

Earthquakes (W. R. 77).—The cause of the oppressive weather before an earthquake is due to the stopping or diminution of the wind as shown by self-registering instruments. The barometer is also affected, and there is a tendency for stratus to form over the sky. There are not enough earthquakes in Jamaica to complete the investigation, but the recording instruments are kept constantly in perfect working order.

Health of Kingston (W. R. 123).—The connection between the meteorological results and the health of the chief town in Jamaica is interesting in many ways. In Jamaica the people suffer from cold, not from heat. There are nearly twice as many deaths in March after the cooler weather in January and February as there are in September after the hotter weather in July and August, and this is accentuated with respect to infantile mortality; for infants the ratio is thrice instead of twice.

Lightning, protection of buildings from (W. R. 136).—Confirming the report of the British Lightning Rod Conference, 1882.

Magnetic variation (W. R. 182).—Between the years 1700 and 1820 the variation of the compass was practically steady. Of late years it has been rapidly changing; the results of the investigation are given in a practical form.

Rainfall maps (published by the Jamaica Institute).—The colored maps are based upon observations made at about 153 stations for about twenty years, and they show the average distribution over the island for each month.

Rainfall and sun-spot period (Nature, vol. 49, p. 399).—The table given in Nature takes in Barbados, Antigua, and Trinidad, as well as Jamaica. It does not seem to be of much use for forecasting purposes. In 1898 I gave out that that year and the next few years would probably be drier than usual—the sun-spot maximum was then approaching, and 1891 had been unusually wet—but 1893 proved to be still wetter, and it was not until two or three years after the maximum in 1893 that drought was severely felt in certain parts of the Island, and the connection preserved.

Results, meteorological (W. R. 123).—These are for the most part means for ten years, 1880–89, with notes.

Temperature and pressure (Nature, vol. 35, p. 437, and vol. 36, p. 197).—The decrease of minimum temperature as we ascend in the air follows a law which is useful in many ways, and if we define the temperature of space to be that shown by a thermometer at a great distance from the earth and shaded by the earth from the sun, we find its temperature to be -311°F .

Tides in Kingston Harbor (W. R. 227).—When the moon's declination is small there are two very small tides in the twenty-four hours; when the moon's declination exceeds 9° north or south there is only one small tide in the twenty-four hours. This investigation is referred to here in consequence of the discovery of the variation of mean sea level with monthly temperature of the air. Let T be half the sum of the mean temperature of the air for any month and for the preceding month, then the

Mean sea level = constant + $0.84 \text{ inch} \times (T - 78.6^{\circ})$. This seems to show that the variations of T are carried down as much as 500 feet below the ocean level.

Winds in Kingston (W. R. 200).—A careful investigation of the sea and land breezes by Mr. Brennan, as felt in Kingston.

The monthly form accompanying this article shows that the Jamaica Weather Service calls for the following data from its stations:

Latitude, longitude, height of barometer above mean sea level, height of rain gauge above mean sea level and above ground.

Barometric pressure at 7 a. m. and 3 p. m., reduced to standard temperature, the Kew standard barometer, standard gravity, mean sea level.

The air temperature (7 a. m., 3 p. m., max., min.) by corrected thermometers exposed on a lawn in a Stevenson screen.

The dew-point and relative humidity, 7 a. m. and 3 p. m. from the readings of the dry and wet bulb thermometers by Glaisher's Tables.

The rainfall at 7 a. m. daily, for the preceding twenty-four hours, as given by a rain gauge 8 inches in diameter.

The total daily movement of the wind at 7 a. m., as given by a small Robinson anemometer, in which the factor 3 is used.

The direction and velocity of the wind at 7 a. m. and 3 p. m., using the true meridian, and, if necessary, the estimated wind velocity, according to the Signal Service scale (light 1 to 2 miles per hour; gentle, 3 to 5; fresh, 6 to 14; brisk, 15 to 24; high, 25 to 39; gale, 40 to 59; storm, 60 to 79; hurricane, 80 and over).

Clouds, kind, amount, and direction of motion at 7 a. m. and 3 p. m., classified as lower, viz, fracto-stratus; middle, viz, cumulus; upper, viz, cirrus and cirro-stratus.

RAINFALL AT RIVAS, NICARAGUA.

By DR. EARL FLINT.

Dr. Earl Flint, voluntary observer at Rivas, Nicaragua, has kindly furnished the accompanying table of monthly and